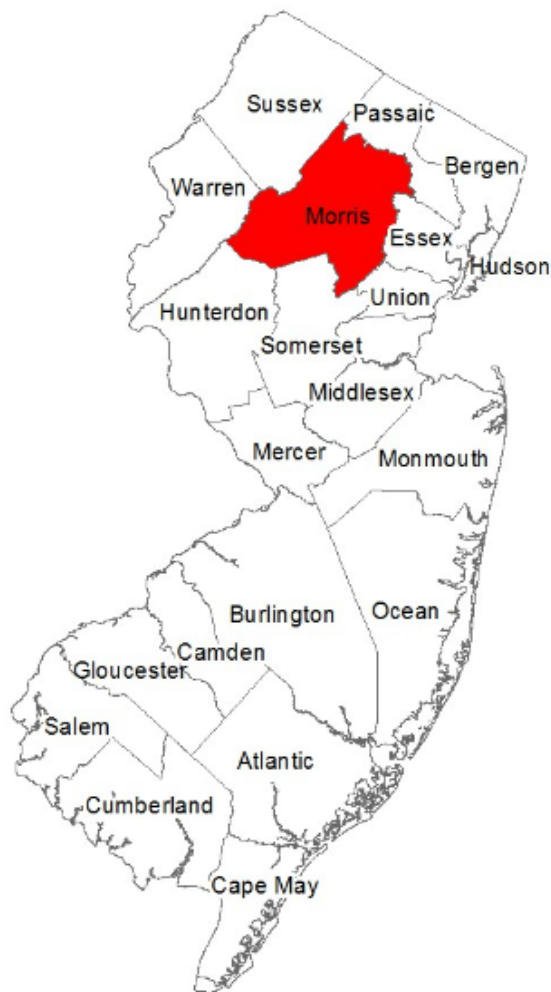
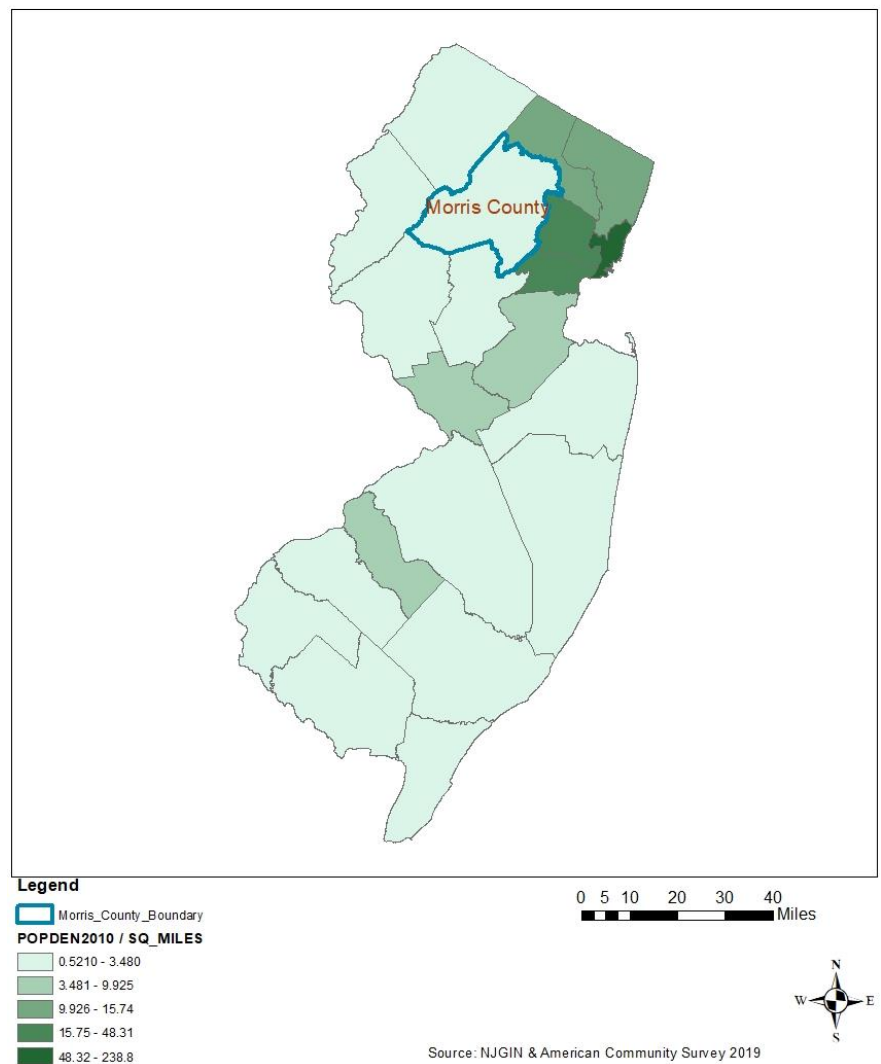


# Morris County Hospitalization Capacity

The county under scrutiny is a derivative of the county called Hunterdon. It enjoys its seat at the forehead of NJ. However, its population density is not as large as other counties of NJ which is why it often gets ignored by students who want to analyze a county. Nonetheless, this county was explored to analyze how good or bad it has set its hospitality infrastructure to cater 0.5 million population living there.

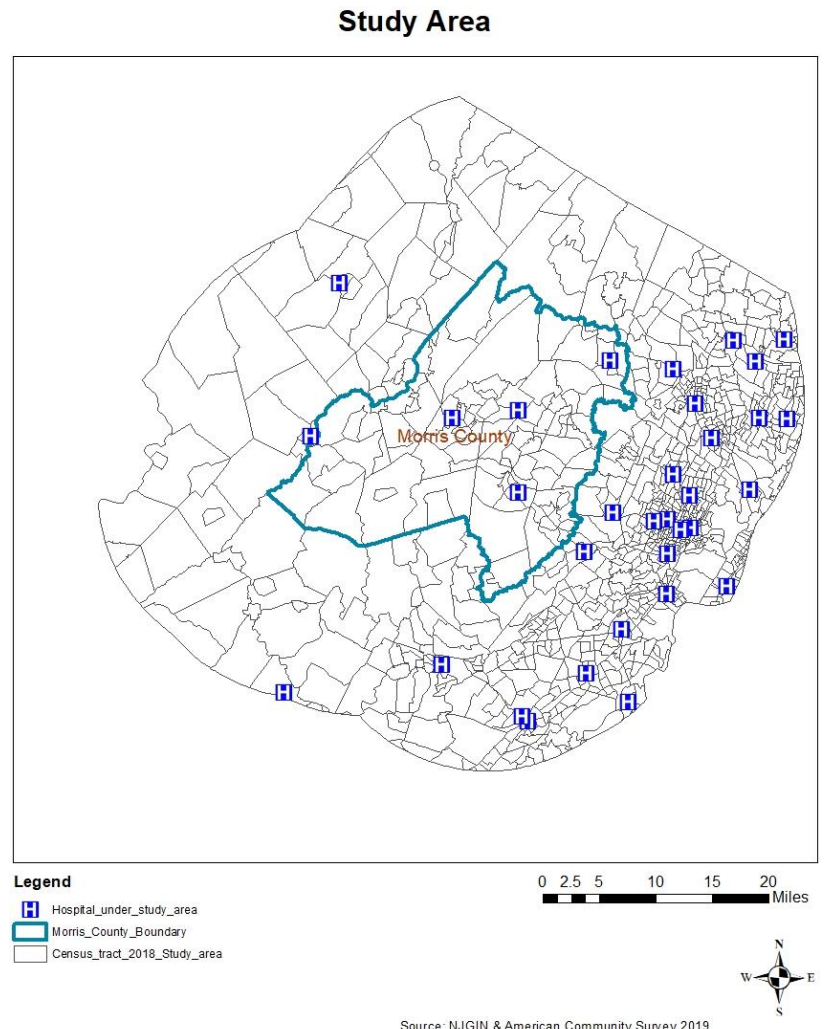


**NJ County Population Density 2010**

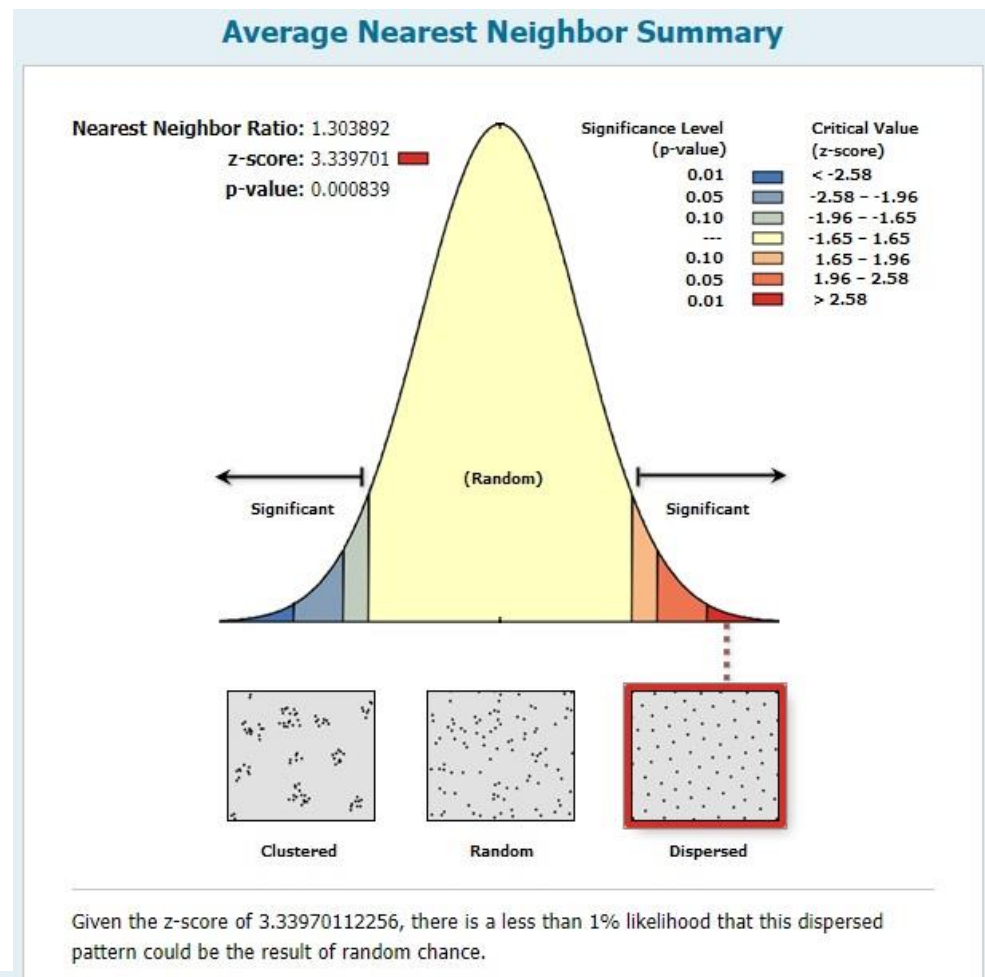


But before any analysis could begin, a study area was defined for the county which included census tracts from other neighboring and non-neighboring counties as well. This is because it is possible that Morris county residents turn towards non-Morris hospitals due to closure. Which is why a buffer was calculated from the boundary of Morris county by assuming that the average speed of traveling towards hospitals is 30 miles an hour. The distance for the buffer was calculated by multiplying this speed with the maximum time that a Morris County resident would want to travel towards any hospital which was half an hour (30 mins). The resulting buffer provided the following study area:

As can be seen, that Morris County itself had only 5 hospitals, however, the eastern neighboring tracts of Morris County happen to be glutted with a lot of hospitals which. Therefore, an Average Nearest Neighbor analysis was done to deem for clustering and dispersion possibilities in the study area. The results of the ANN were done using default values for threshold and increasing distance, and the results are displayed as follows.



What was observed was that the hospitals distribution was dispersed and there was a 95 percent chance that this was not due to random chance. Due to the statistical significance of



### Average Nearest Neighbor Summary

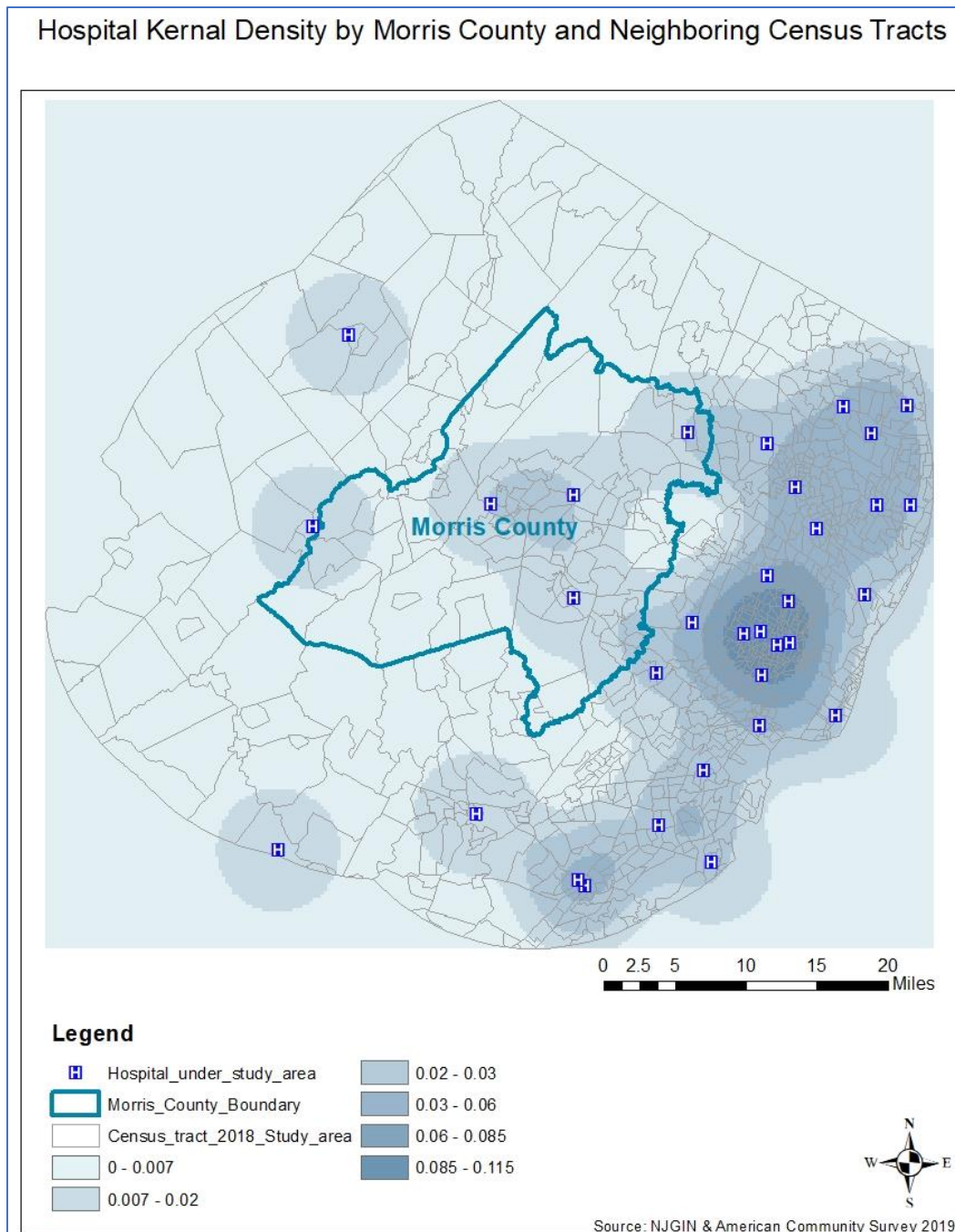
<b>Observed Mean Distance:</b>	23408.5296 US_Feet
<b>Expected Mean Distance:</b>	17952.8086 US_Feet
<b>Nearest Neighbor Ratio:</b>	1.303892
<b>z-score:</b>	3.339701
<b>p-value:</b>	0.000839

### Dataset Information

<b>Input Feature Class:</b>	Hospital_under_study_area
<b>Distance Method:</b>	EUCLIDEAN
<b>Study Area:</b>	42544040510.216949
<b>Selection Set:</b>	False

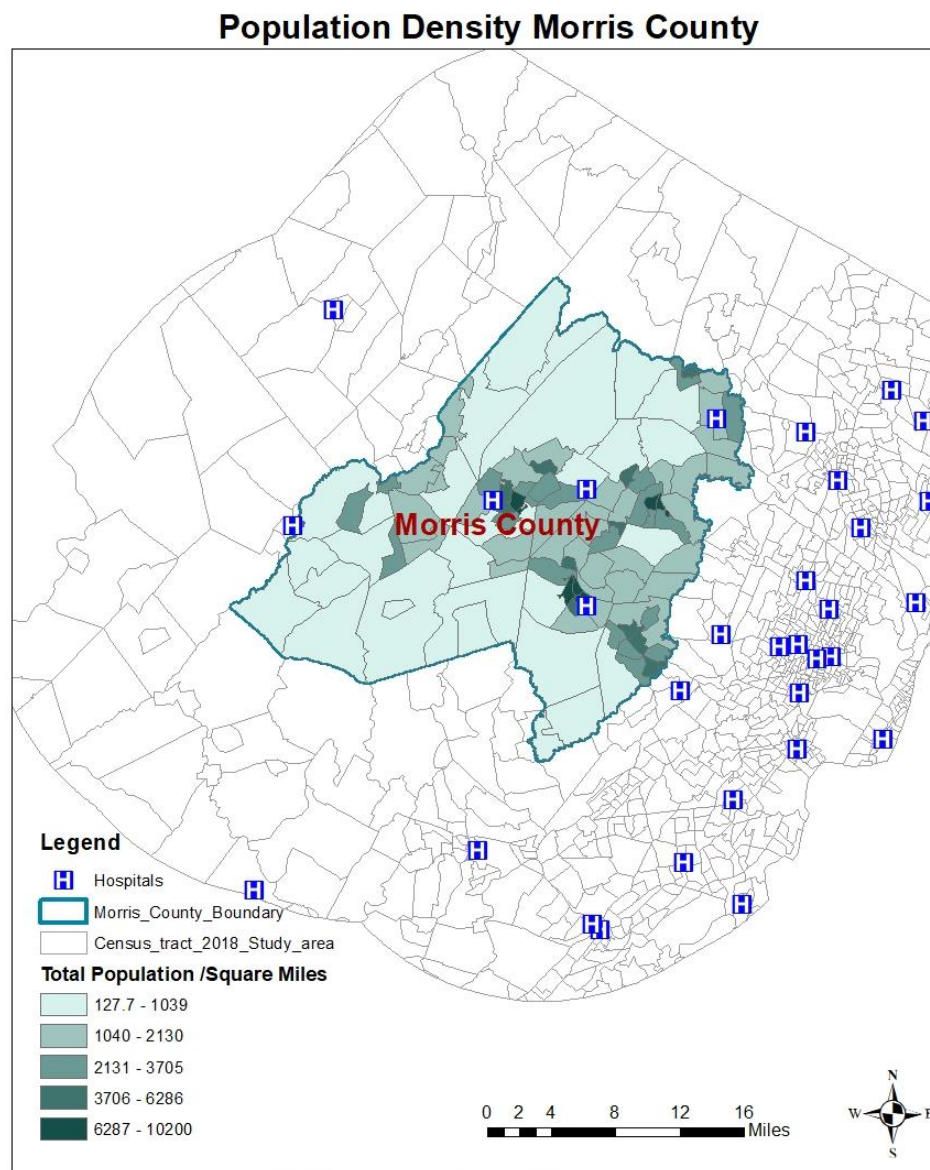
the model, the preconceived notion of there being clustering was eradicated and further analysis was done as now hospitals were dispersed throughout the study region.

Due to this a Kernel Density was performed on the hospital data points, which showed that the county itself does not experience a large portion of the density of the hospitals and there was room for more hospitals inside Morris County. This then became the hypothesis of this project.



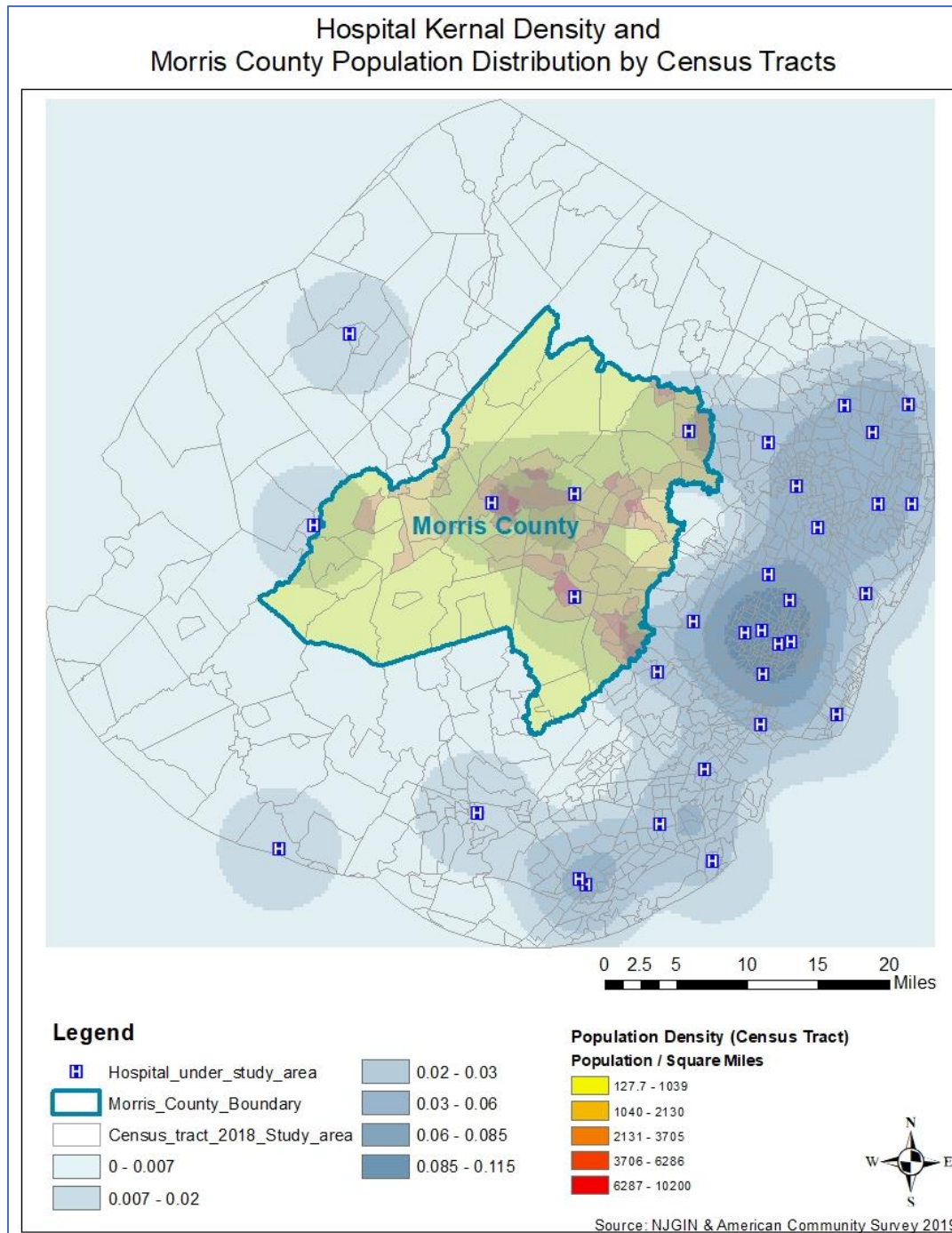


But, before any abrupt recommendation could be made, a population density map of Morris County Tract was made to see for the possibility of there being areas that are not inundated with people which might be the reason for lesser hospitals. The population density map shown below was made by joining American Community Survey's 5-year population estimate from 2019. This gave total population estimates for all 100 census tracts in Morris County.



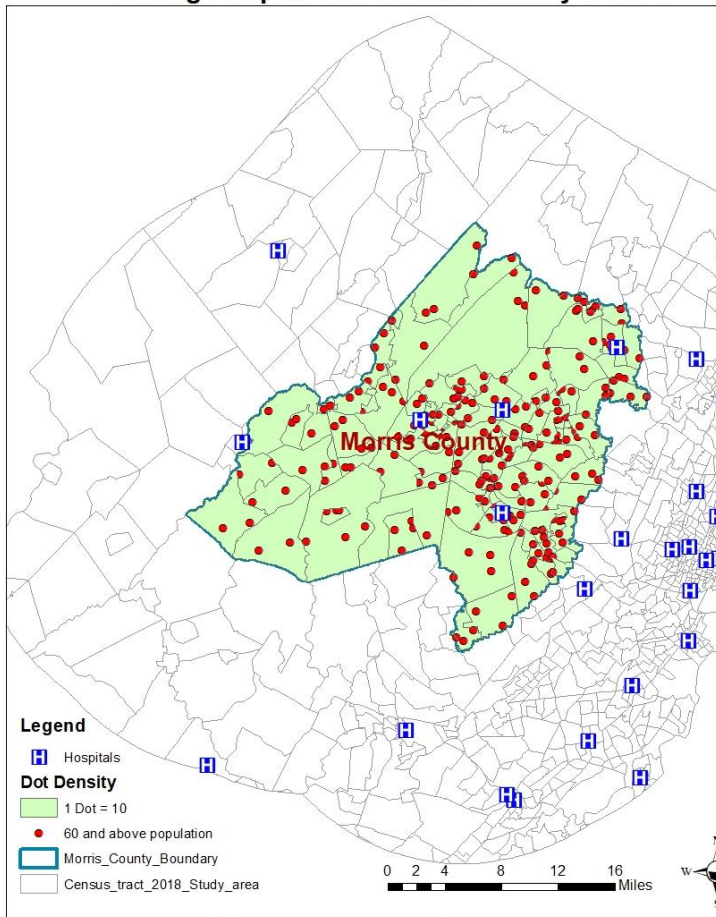
The population density map was coupled with the kernel density layer of 33 hospitals in study region to better assess the outlook:

This figure gives a better understanding of how the tracts in the middle and east of Morris County are having more people living per square mile and are also getting catered within the Kernel Densities of Hospital.

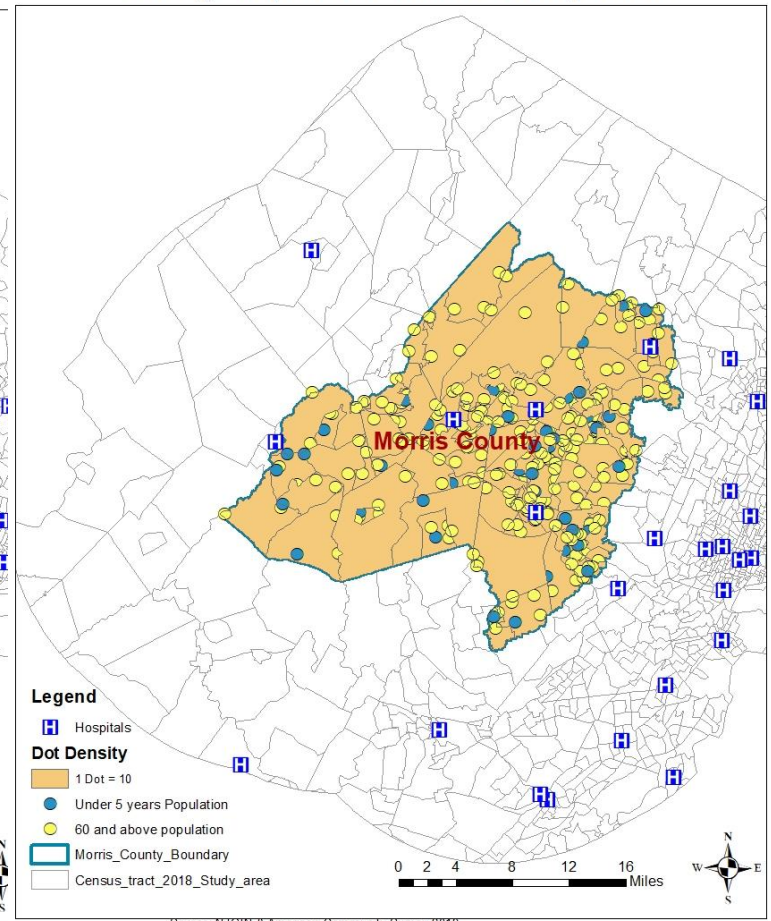


However, more demographics were explored to see the possibility of there being any demographic group that was not getting catered well, given the current population distribution. For this, more demographic datasets were downloaded for Morris County Census tract from ACS and maps were made which can be seen below:

**Old Age Population - Morris County Tracts**



**Old Age Population - Morris County Tracts**



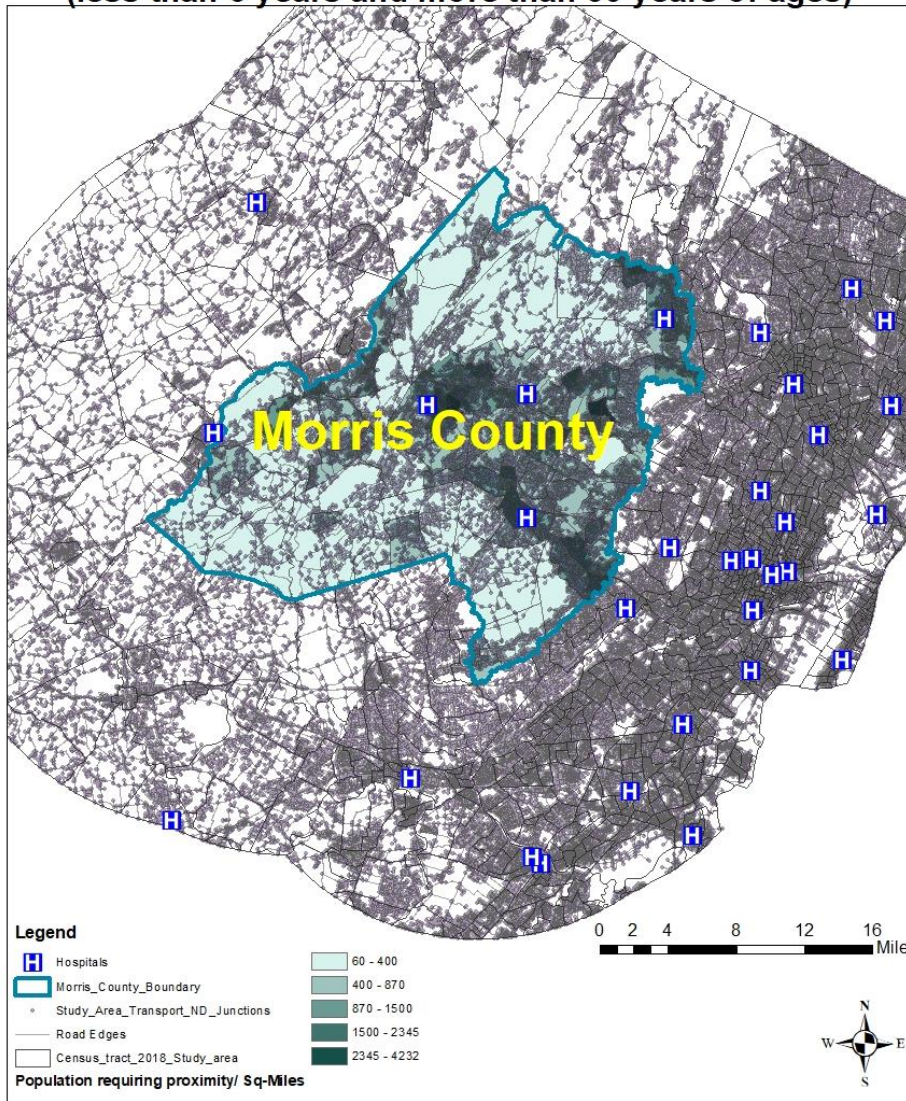
The figures above give way to another hypothesis that perhaps old aged people and minors happen to be present in areas, especially in the South of Morris County which is not in close proximity to hospitals inside the study region. This is why it became necessary to find location for a new hospital inside NJ.

For the purposes of selecting the best region (tract) for a new hospital, a network dataset was created using the Roads Centerline data downloaded from NJGIN website. This data was clipped to the study region. A travel time field was created to include traveling time impedance. This was done by selecting roads that were greater than 1 mile and assigning



them an average speed of 50 miles an hour. And roads less than 1 mile in length were assigned a speed of 20 miles an hour. This was then used along with each road respective length to calculate the time it takes to traverse that road. The census tracts inside Morris County were converted to centroids and them along with Hospitals were snapped to the network dataset roads and the following map was designed to depict the network dataset along with the theme of focus of this project:

### Morris County Population Requiring Proximity to Hospitals (less than 5 years and more than 50 years of ages)

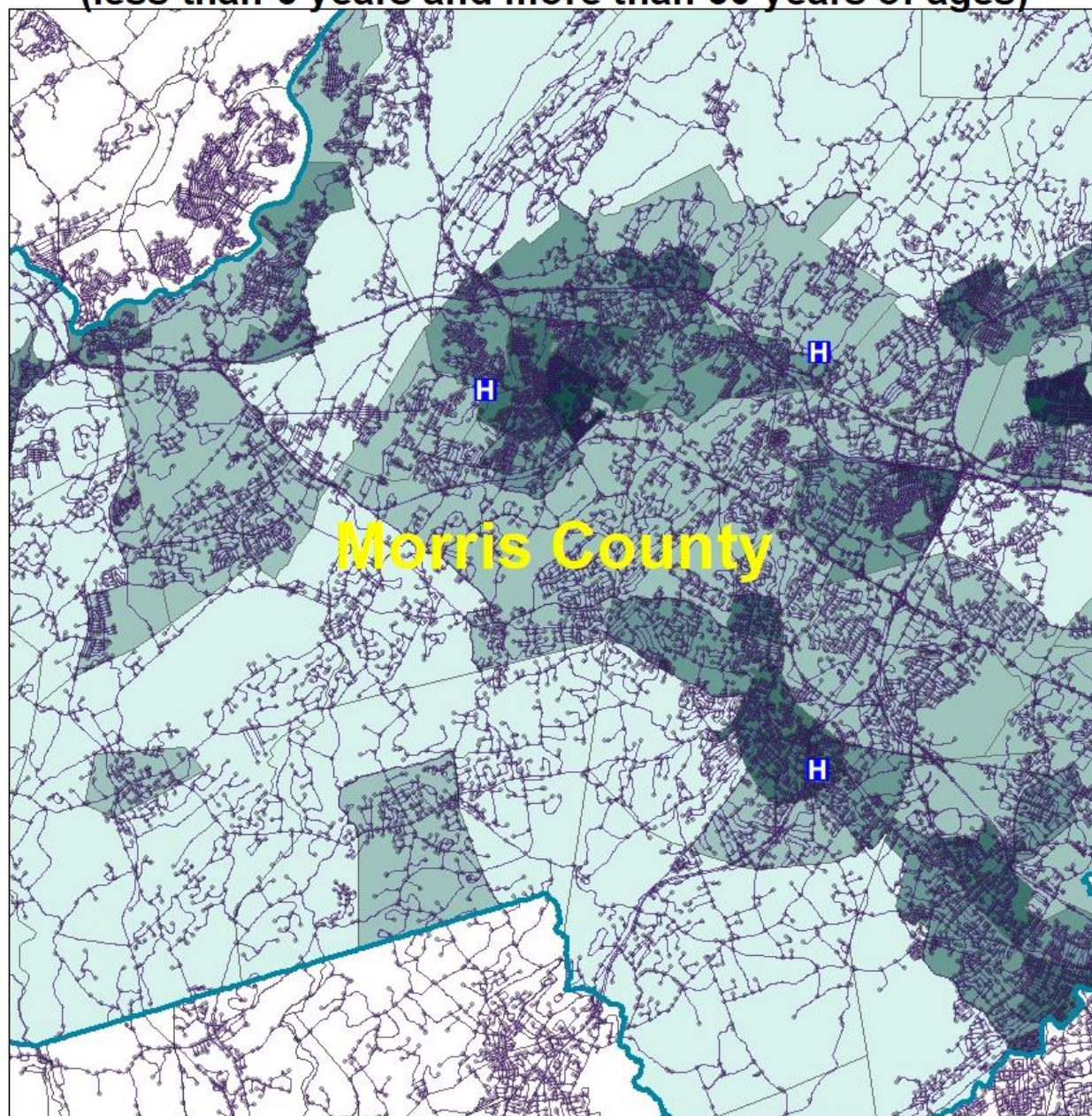


The theme in the map to the left was customized by summing population counts for people who were minors and people who were more than 50 years of age. This is because these are the ages, which as per the hypothesis would need more proximity to hospitals than the rest of the age groups.

A closer look to the map shows that the preliminary position of the new hospital should be somewhere in the mid eastern region because the critical population is situated there as well as most of the population:



## Morris County Population Requiring Proximity to Hospitals (less than 5 years and more than 50 years of ages)



### Legend

- Hospitals
- Morris\_County\_Boundary
- Study\_Area\_Transport\_ND\_Junctions
- Roads\_Centerline
- Road Edges
- Census\_tract\_2018\_Study\_area

### Population requiring proximity/ Sq-Miles

- 60 - 400
- 400 - 870
- 870 - 1500
- 1500 - 2345
- 2345 - 4232

0 0.5 1 2 3 4 Miles

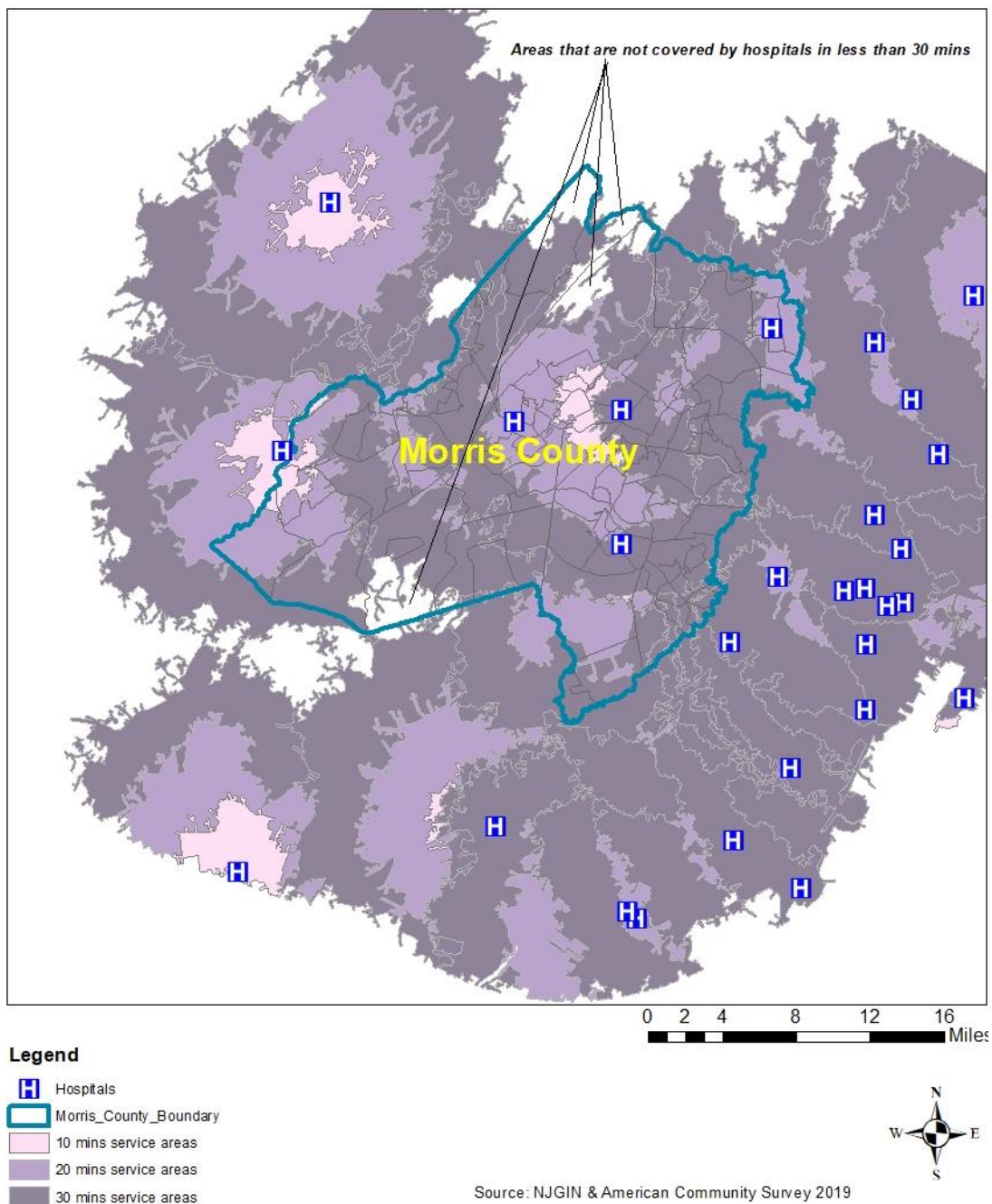


Source: NJGIN & American Community Survey 2019

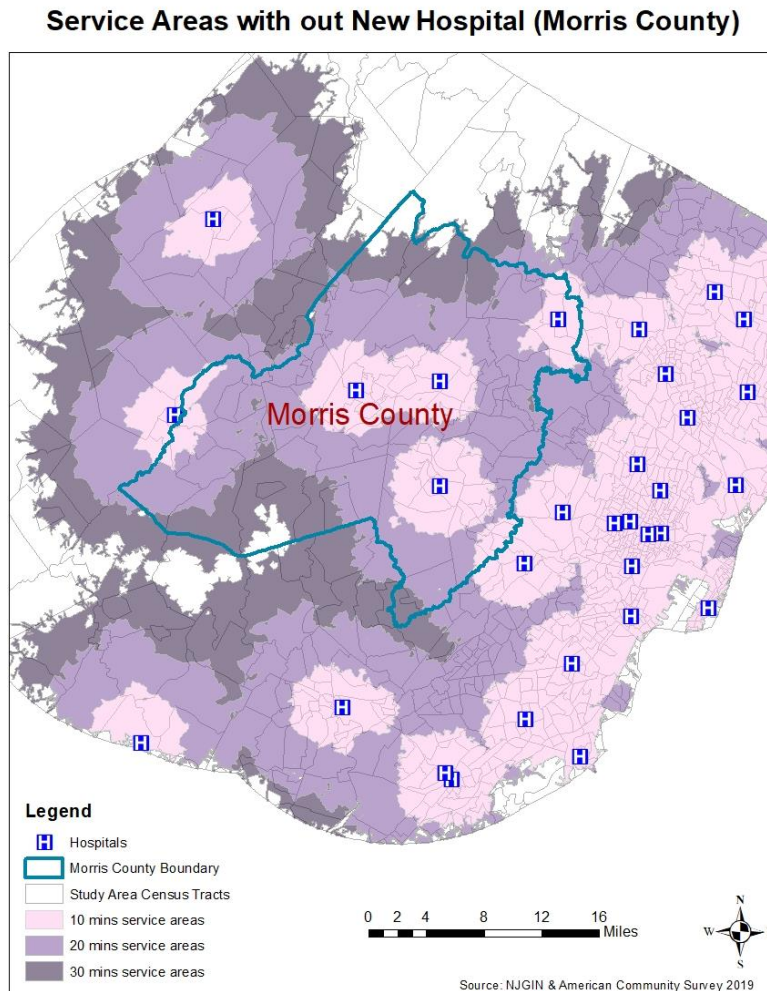


But again, before jumping the gun on the position for new hospital, a service area analysis was done to find areas of Morris County that were accessible within 10, 20, and 30 minutes from the given set of hospitals within the study area. The map below is constructed by merging all the polygons of service areas which shows that there are few census tracts inside that are uncovered within 30 mins.

## Hospital Service Areas for Morris County Residents



A similar map is constructed, with same number of hospital facilities, but this time by merging service area polygons only by their respective break values. This gave a better understanding that although, still those tracts remain uncovered within 30 mins, there are quite few tracts, relatively, that are covered within 10 mins.

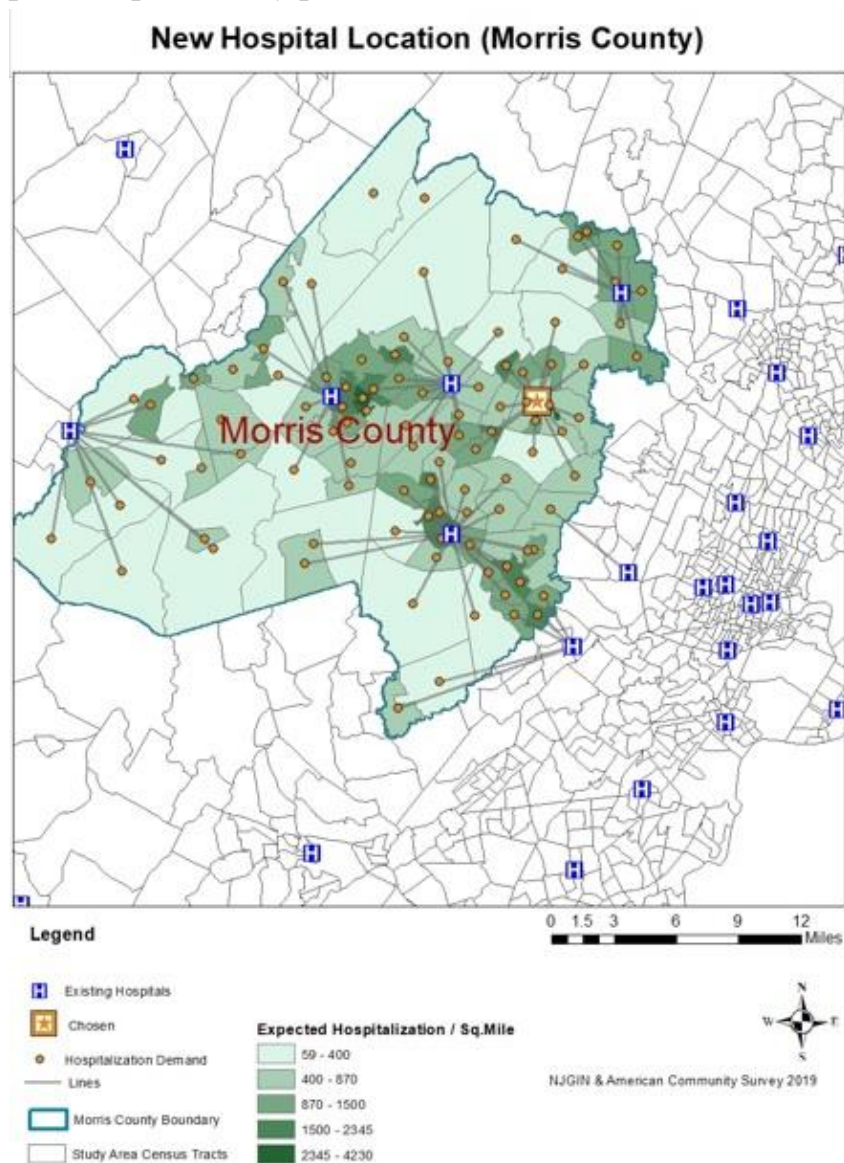


As planners, it would be desirable to locate the new hospital in an area that serves the greatest demand of hospitals without exceeding its capacity of hospitalization.

To go about this, two metrics were devised, namely: Expected Hospitalization and Annual Hospitalization Capacity. For the Morris County, hospitalization rate was 876.5 per 10,000 people. So, each tract's population was multiplied with this and divided by 10,000 people to get the expected hospitalization in each census tract (this was the demand). And since for NJ, average hospitalization lasts 5 days, so one bed in a hospital could on average cater 73



hospitalizations. So, the capacity of each hospital point was calculated by multiplying number of beds with 73. The allocation-location model solved for 133 facilities, of which 100 were candidate (because there were 100 census centroids) and 33 were existing hospitals. The demand points were also 100 census tract centroids, but their demand was equivalent to the expected hospitalization rate. And the solver used was called Maximize Capacitated Coverage. The default capacity for the candidate locations was set to 18250 hospitalizations in one year (250 beds \* 73). And an impedance cutoff was set of 30 mins. This model was the perfect model for planning as it catered for time impedance, as well as capacity of existing hospitals in study area, along with the demand for each location. Consequently, the chosen location of new hospital turned out to be in the region that has been previously proposed in preliminary phase:

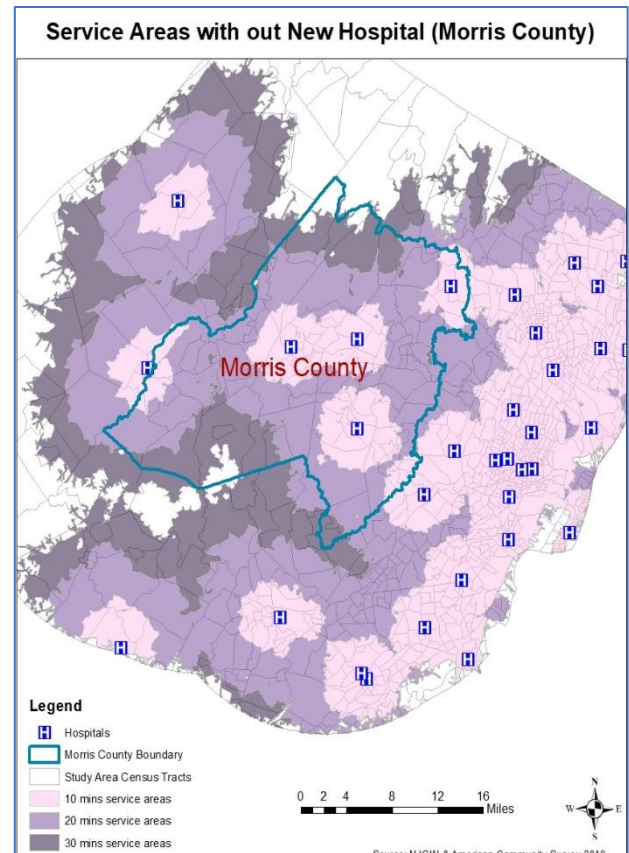
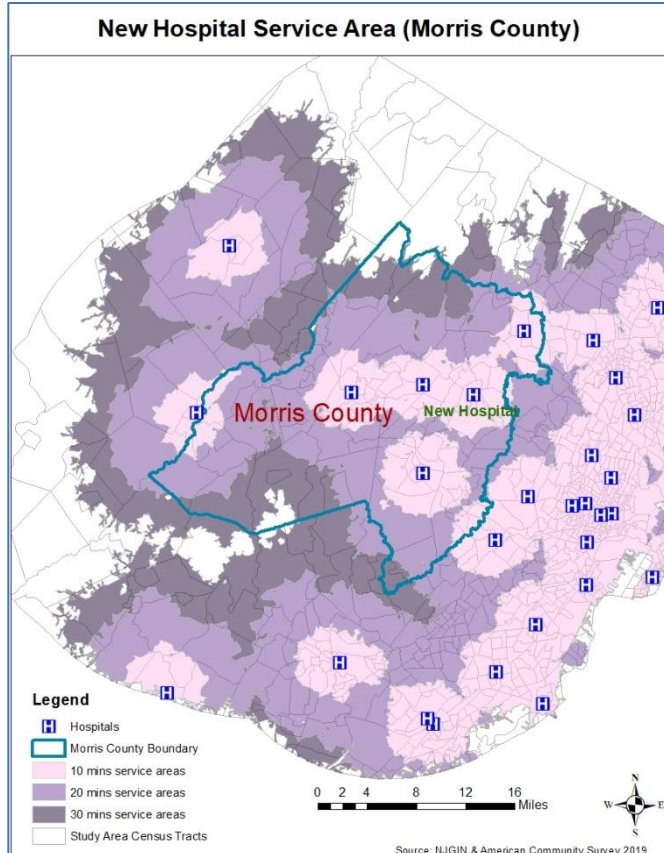


## Summary:

Upon the addition of a new hospital, we see that the service area in that region, which was previously reachable in 20 mins, has now become an area reachable within 10 mins. This is a valuable addition as the area in which it has been placed was glutted with people, especially those people who were classified as critical population in this study, which means they are in a proximity to a hospital and do not need to travel far. This would have massive impact on the health and well-being of the residents of Morris County.

Moreover, the model did not deem adding the new hospital in the vicinity of those tracts that were unreachable within 30 mins. This apparently means the demand for hospitalization was higher in the middle region and were unmet given the impedance of 30 mins set.

Nonetheless, it would be interesting to note what the results of the location-allocation model would be if the time impedance is not set as impedance. This would be the next step of this study. If upon conducting this it is found that the new hospital location should be near the tracts that were unreachable within 30 minutes previously, then it would be a crucial planning decision to undertake of whether to build the new hospital there or in the heart of Morris county (as in the left picture above). This study



would, however, suggest using the results of the location allocation model including the time impedance and build the new hospital in the location shown above.